The Journal

OF THE AMERICAN SOCIETY OF SAFETY ENGINEERS

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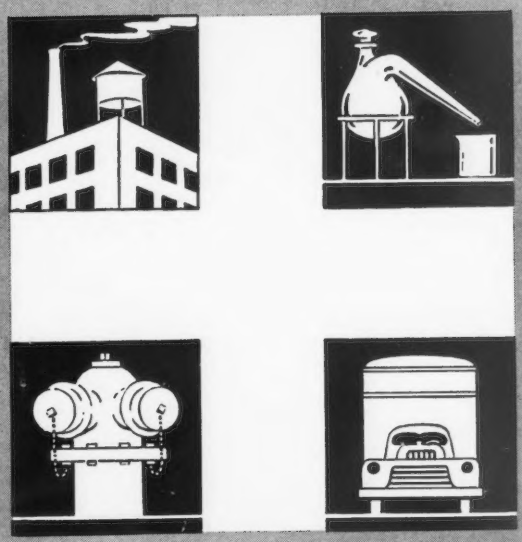

NOVEMBER, 1959
Volume IV Number 4

Award Plan Encourages Journal Article Authors

■ WITH THIS ISSUE the *Journal* is rounding out its fourth year of publication. In its brief history, significant changes have taken place in the American Society of Safety Engineers. Just within the last year, the Society's national headquarters has moved into an independent office, away from its friend and former landlord, the National Safety Council. Also, a new national secretary and managing director has been elected to head Society administration.

Another important development which should directly benefit the *Journal* and its readers has been the establishment of an Annual Technical Paper Award Plan, cosponsored by the Society and Veterans of Safety to recognize the best articles, by members of either organization, which have been accepted by or published in the *Journal* during the award year.

In addition to award plaques and Honorable Mention Certificates, first and second prize honorariums of $100 and $50 have been established. Initial awards under the plan are being made this October 20 at the National Safety Congress shortly after this *Journal* issue goes to press.

In the past the *Journal* has tried to give its readers stimulating material on as many phases as possible of the safety field. It is our hope and belief that this new award plan will encourage authors to make more contributions to our publication so that we may serve our readers with an even broader coverage of accident prevention than we have been able to achieve during our first four years.—Editor.

AMERICAN SOCIETY OF SAFETY ENGINEERS

Organized 1911—Chartered 1915

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OUR PRESIDENT SPEAKS ON SAFETY

BEING ELECTED PRESIDENT of the American Society of Safety Engineers is a signal honor for me and I am deeply appreciative of this expression of confidence from our membership. The defined objectives of our Society, together with the high standards of professional performance established by our members, makes this office one of great responsibility and trust. Within the limits of my ability, during my term I shall try to give our Society a leadership, consistent with the tradition created by my predecessors, which I hope will help our Society grow both in stature and professional recognition.

Just having taken office, I find there is one subject I particularly want to discuss with you. At present, some of our members are questioning whether we are properly named and whether we are strictly an engineering society. Apparently there is confusion in some minds as to the definition of safety engineering and proper qualifications for Society membership.

It is my personal opinion that safety engineering is not nearly so much a matter of *definition* as it is a matter of *performance*. The important considerations are what we do and how well we are equipped to do it. Whether or not we are called engineers is not nearly so important as that we be professionally qualified.

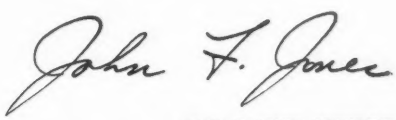
However, we cannot escape the fact that the fundamental principles of accident prevention are basically engineering in their original concept. The genesis of this philosophy is expressed in the foreword of the Canons of Ethics for Engineers, which states: "It is the engineer's duty to interest himself in public welfare and be ready to apply his special knowledge for the benefit of mankind. . . . He will have due regard for the safety and life and health of the public and he will guard against conditions that are dangerous or threatening to life, limb or property in work where he is responsible."

With today's rapid technological advances, we have observed many changes in the concepts of engineering as originally expressed by the various "founder" societies 40 to 50 years ago. Most significant of these changes, I believe, is that human engineering has taken an equal place with the technical phases in almost every branch of engineering.

It also is true, in my opinion, that we in safety can draw a close parallel between our profession and that of medicine. Both are dedicated to the preservation of human life. In medicine, the era of the general practitioner seems to be almost over. We now have the diagnostician, surgeon, pediatrist, psychiatrist, ophthalmologist, etc., with professional training in their specialties in addition to the broad medical education required for all.

The same is true in accident prevention work; we too are moving into an age of specialization. Some of our members serve the chemical industry, or steel, petroleum, public utilities, atomic energy, traffic, farm and home, highway, small business, schools. Others are engaged in teaching, statistical work or research. Like the doctor, the modern safety engineer seeks more specialized training and a higher degree of technical competence to meet the increasing demands of his profession.

We have established a good name—American Society of Safety Engineers—and a proud heritage. It is up to us to keep it that way. Let's not cloud the issue by jousting with definitions. Let's concentrate on keeping our membership standards at a high professional level, based on demonstrated technical competence, so that the abilities of our membership may always be equal to the modern world's ever expanding needs for our services. Only in this way can we properly protect human life and conserve physical resources. And of course this is our responsibility for today and our challenge for tomorrow.



JOHN F. JONES, PRESIDENT
AMERICAN SOCIETY OF SAFETY ENGINEERS

EVERYBODY UNDERSTANDS MONEY

BY PHILIP J. BAILEY

for reports to management, author replaces frequency and severity rates with "estimated loss ratio" as more accurate measure of safety performance

BACK IN 1951 when I changed employers, I succeeded in selling my new boss on the idea that frequency rates and severity rates should be thrown out of the window. It was because he trusted my judgment in these matters that he gave me his permission to swing away from the accepted American Standard Method of Recording and Measuring Work Injury Experience.

We have not used it since *for the purpose of determining our safety performance.*

Of course we still compute frequency and severity rates, because they still are necessary for reporting to the National Safety Council, the Bureau of Labor Statistics and other government agencies.

But we do not use them for any other purpose.

Why did I insist that we do this when practically every other company with an organized safety program uses and accepts these two established formulas for measuring accident experience? I insisted—and won my point—because I believed that frequency rates and severity rates cannot accurately and consistently measure safety performance and injury cost.

I was further motivated because, through the years I had been in the safety business, I had seen too many safety men become fanatics about these twin decimal point demons and do almost anything in order to hold them down in size.

I had seen too many reportable injuries that remained "first aid cases." I had heard safety men swapping stories about the painfully injured people who were heckled into hobbling into work to be temporarily employed on "regularly established jobs."

Most of these jobs, I found, were *established regularly* to take care of working cripples who should have been at home giving their work wounds a chance to heal.

But instead, these "first aid cases" had to help win a plaque or a certificate or a flag—or help to complete the million manhours of "no lost time"—all of this so that the safety man could boast to management about a frequency rate of low-point-zero and a severity rate of microscopic size.

Meanwhile, back at the plant hospital, business was booming. And the experience rating calculated by the insurance company continued to push the premiums for workmen's compensation upward to take care of the increasing costs of the injuries, which continued to mount in number despite the official published frequency and severity rates.

Frequency and severity rates, no matter how honestly they are used, still are not good measuring devices for accident experience. They place entirely too much emphasis on the stamina of the injured person and on the part of the body that was injured.

Finger injuries in many industrial plants frequently are not considered to be reportable. Only occasionally will they become a part of the frequency rate; hardly ever are they reported in the severity rate. Yet if the same type of accident causes a *toe injury,* the accident probably will appear statistically in both the frequency and the severity rates.

In heavy industry, where the light job is unlikely to be found, severity rates are higher than in light industry. One of the reasons for these higher rates is that regularly established jobs cannot be found for the temporarily crippled employe.

Occupations requiring agility, like construction work, are more likely to experience disabling injuries than occupations where the employe operates a machine or works at a bench.

Frequency rates and severity rates *do not reflect accident costs.*

Checking my own accident cost figures, I find that in one year when we had a frequency rate of 9.5 and a severity rate of 350, my accidents were costing me $6.66 a thousand manhours. Yet, in another year when my frequency rate was down to 3.5 and my severity rate was 127, my accident costs went up to $9.23 a thousand manhours. Both severity rates included the time charges and the costs are actual costs, not part of any 4-to-1 or 5-to-1 formula.

Philip J. Bailey, safety engineer for Walter Kidde and Co. since 1951, entered safety work 18 years ago, joined our Society in 1950 and is a member and past treasurer of the New Jersey Chapter. Author of many safety articles, his paper, "The Mean Amines," was published in the November, 1956, *Journal.*

MONTHLY ACCIDENT EXPERIENCE Month June 1959

	THIS MONTH	PREVIOUSLY REPORTED	CUMULATIVE
Number of Manhours Worked	310,152	1,434,086	1,744,238
Number of Reported Accidents	16	28	44
Frequency Rate of Reported Accidents	51.6	19.5	25.2
Number of Disabling Injuries	1	7	8
Frequency Rate of Disabling Injuries	3.2	4.8	4.6
Number of Actual Days Lost	62	191	253
Severity Rate of Actual Days Lost	200	133	145
Number of Permanent Disabilities	0	0	0
Time Charges	0	0	0
Severity Rate of Time Charges	0	0	0
Total Incurred Loss (Estimated)	$2,362.00	$6,473.00	$8,835,00
Loss Ratio per 1,000 Manhours	$ 7.62	$ 4.51	$ 5.06

CUMULATIVE LOST TIME AND DISABLING INJURIES

Acc. no.	NAME OF INJURED	DEPT.	DATE OF ACCIDENT	CODES			DAYS LOST	TIME CHGE.	MEDICAL & COMP. COST	
				AGENCY	CAUSE	RESP.			ESTIMATED	ACTUAL
3	A..... K.....	940	2- 6-59	8	23		29		$ 450.00	
4	A..... J.....	720	2-19-59	8	23		11		192.50	
7	R..... S.....	520	3-10-59	16	5		61		1,250.00	
15	A..... O.....	311	4- 6-59	11	9		20		410.00	
18	G..... S.....	370	4-11-59	23	5		57		433.00	
22	A..... C.....	530	4-14-59	1	13		25		500.00	
25	F..... S.....	777	5-27-59	16	5		32		2,000.00	
32	M..... T.....	772	6- 3-59	11	5		18		350.00	

Monthly Accident Experience Report—second section lists only lost time or disabling injuries (cumulative)

Even though I insisted and won my point with my boss that we stop using frequency and severity for measuring safety performance, I knew that I had to have a yardstick. I needed a true, honest, firm yardstick to see and measure where we were going, safety-wise and cost-wise.

So I introduced my boss to "Estimated Loss Ratio"—and they have been "going together" ever since. Over a period of eight years, we have found it to be an excellent device for measuring accident prevention performance because it measures that performance in *real dollars*. Money is something that management is interested in and understands.

What is Estimated Loss Ratio?

For us it is the estimated cost of work injuries per each thousand manhours worked.

What is the formula?

Manhours, divided into Estimated Accident Costs, equals Estimated Loss Ratio.

Now you probably are asking, "And just how does he go about getting his estimated accident costs?

I get mine the hard way. I go down to the insurance company each month with the copies of our reported accidents clutched in my hands. I sit down with the claims supervisor and we quickly go over these injuries. And to the insurance company they are injuries, not accidents. Together we estimate a reasonable reserve for each reported injury. We do not always guess it right on the nose but the overall picture in our "guesstimations" averages out to within five per cent of the actual incurred losses.

Here is an example of how we might compute our Estimated Loss Ratio for a given month. This example is a fictitious example—but let us say that on

MONTHLY ACCIDENT EXPERIENCE Month June 1959

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CUMULATIVE LOST TIME AND DISABLING INJURIES

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Monthly Accident Experience Report—second section lists only lost time or disabling injuries (cumulative)

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Here is an example of how we might compute our Estimated Loss Ratio for a given month. This example is a fictitious example—but let us say that on

this mythical month we report nine injuries to the insurance company:

INJURED		ESTIMATED RESERVE
John Doe	5/2	$1,000.00
Geo. Brown	5/7	25.00
Ed. Hart	5/8	40.00
M. Sadler	5/11	320.00
L. Williams	5/19	25.00
K. Anders	5/23	1,500.00
B. Totten	5/24	100.00
N. Norman	5/24	40.00
W. Nice	5/29	25.00
		$3,075.00

Manhours for the month: 356,841.

356,841 manhours divided by 1000 (to reduce from millions to thousands), equals 356.8 divided into $3,075.00 equals $8.59 per thousand manhours, the estimated cost of accidents for the month—or, Estimated Loss Ratio.

During the years that we have been using this formula, we have established a line at $7.00 per thousand manhours and we attempt to stay below this line. For us an $8.00 loss ratio is "satisfactory." $7.00 is "good." $6.00 is "very good." $5.00 is "excellent." Under $5.00 is "superb!"

A word about the two charts appearing with this article and why there appears at first glance to be a difference in the level of the loss ratio for June, 1959:

The "Monthly Accident Experience" table on page 51 is exactly that—the experience on a month-to-month basis inside a calendar year. Shown is the June, 1959, experience under "This Month." Under "Previously Reported" is the experience for the first five months of 1959. The "Cumulative" is of course the accumulated first six months of 1959. The "Cumulative Lost Time and Disabling Injuries" section lists only those injuries which fall into either or both of those classes.

The "Loss Ratio" chart shown below differs from the monthly experience table only in the fact that it is a *moving 12 months average*. Each point on this chart shows our loss ratio, not for that month but for the 12 month period ending with the indicated month.

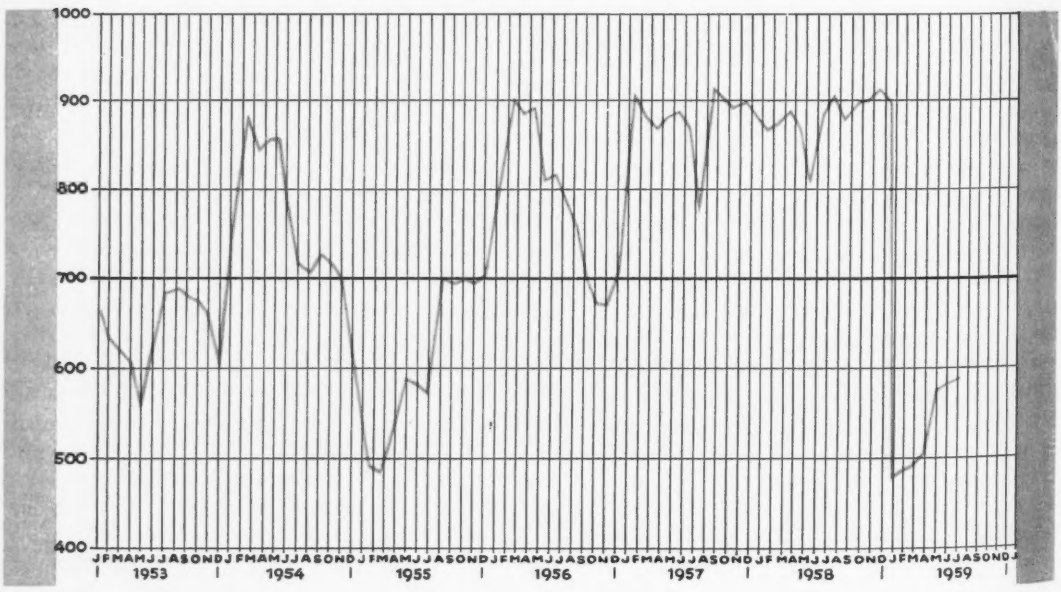
The formula for this chart: I used 1952 estimated costs and manhours as a base. Each month I subtracted the estimated costs and manhours for that month of the previous year, and added these items for the new month. Then: manhours divided into total cost equals Estimated Loss Ratio for the 12 month period.

When I tell our works managers and superintendents in our general safety meeting that last month's Estimated Loss Ratio was $7.62, someone is certain to demand immediately, "And what was it a year ago?"

Everybody understands money.

ACCIDENT EXPERIENCE CHART

loss ratio in dollars per thousand manhours—cumulative 12 month moving average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THE MOST MISUNDERSTOOD SUBJECT IN ACCIDENT PREVENTION

BY MERRILL C. M. POLLARD

ONE OF THE TROUBLES with most of us in safety work is that we tend to complicate the problems with which we are concerned. We attempt to build importance through the development of an organization. We assume responsibilities that are not rightfully ours. At the same time, we are much too modest with the people who are important to our progress.

The primary reason for the position in which we find ourselves today, I believe, is that we fail to understand the fundamentals of accident prevention. Having no sound basis of understanding, our effort is misdirected and ineffectual. That is why the annual waste of human life goes unchanged year after year. We are not good salesmen because we don't know our product. We only know that it is good and desirable and people ought to have some. We call ourselves *safety engineers,* concentrating our effort on engineering problems, when we ought to be using our talent as administrators of accident prevention programs.

There is no questioning the fact that our efforts are largely influenced by accidents that occur. This is the reason, more than anything else, that we should be familiar with all of the factors that are associated with the occurrence of an accident.

PUBLICATIONS MISUSE BASIC TERMS

Pick up any publication dealing with safety that comes across your desk and you will find a misuse of such terms as injury, type of accident and cause. Each is a separate subject and, properly, the terms cannot be used interchangeably. This misunderstanding of terminology in large part explains our misdirected effort, I feel. When our own thinking is confused, how can we expect our managements to assess the value of our work accurately?

Along with the misunderstanding goes our failure to talk the language of production people. We give them facts based on terms we understand and we assume they know what we are saying. Here are some examples of lack of understanding that appeared in a safety publication. Under the heading, "Types of Hand Injuries," was this listing: machine, point of operation; machine, belts and gears; caught between objects; sharp objects; hand tools; burns.

Only one of these classifications, burns, is a type of injury.

Under the heading, "Causes of Accidents," were these terms: lifting, pushing and pulling, falls, machine injuries, material handling, occupational disease, hand tools.

Not one of these classifications has ever been the cause of an accident. Yet how many of us read the article and said to ourselves, "By golly, that's good. It hits the nail right on the head!"

This is what concerns me most of all about our profession. It is time that we set our house in order. With correct facts, properly interpreted, I believe the accident toll in the United States can be reduced to a minimum of 2,000 deaths and 200,000 injuries a year—figures which represent the two per cent of accidents which have been termed "unpreventable." It would take far fewer people than the 7,500 members of the American Society of Safety Engineers. Properly directed, our effort can achieve this seemingly fantastic accomplishment.

Accident prevention is a comparatively simple matter when it is conducted in accordance with three basic principles. And these basic principles comprise the most misunderstood subject in accident prevention work today!

The three essentials of any successful accident prevention program are:

Merrill C. M. Pollard is director of safety for National Gypsum Co., where he has been employed since 1935. A member of the Society since 1941, he currently is serving a second term as Northeast Region vice president. For many years he has represented the Niagara Frontier Chapter on the Executive Committee.

1. An active and sincere interest.
2. A complete knowledge of accident facts.
3. A plan for corrective action based on this knowledge.

It makes no difference where we might choose to direct our effort—highway, home, occupation—these principles apply. In our work we frequently touch on one or another of them. Lasting results come only when all three are used at the same time—and continuously.

Attitude is of primary importance. No responsible person can display a lack of interest, be guilty of disregarding unsafe practice, permit unsafe conditions to exist, condone violations.

In more than two-thirds of our plants we have huge bins in which raw materials are stored. There is a rule that no person enters a bin unless he is wearing a belt with a line attached and that line must be attended by someone up on top. Yet one day, looking for the supervisor of a department, I found him—of course—alone in a bin and wearing no belt. How can he possibly have safety in his operations?

As long as railroad and highway crossings are permitted at grade level, people in automobiles will continue to be killed by trains at those crossings. Until all airplanes and all airports are equipped with the necessary electronic devices, people will meet death in accidents—most of which will be reported as due to pilot error. When boys living on farms are required to be licensed to drive any mechanical equipment, the toll of lives from unskilled operation will virtually cease.

These examples all involve the three basic principles of accident prevention: interest, knowledge and action. We in safety work have not yet sold the idea that what we have to offer is good for everyone. Look at the school fire in Chicago last December. Ninety-three people lost their lives because of a delayed alarm, inadequate exits, combustible material used throughout the interior and unpermitted accumulation of waste papers. These hazards have been known for years. There is not yet enough interest generated in this country to take action.

It must start with the President and our Congress and continue throughout the public offices on state and local levels. Each school board and church parish has a role to play. One can immediately hear the clamor, "But it will cost so much—we can't afford it." However, neither can we afford 100,000 lives and ten million injuries each year.

Anyone who terms this toll the "price of progress" ought to be ashamed of himself. How much more progress could have been added through the efforts of the people killed or incapacitated as the result of accidents!

How many of us in safety work spend our effort in claims activity? This prevents no accidents. We should be spending our time in learning the causes so we can help keep others from being involved in the same kind of accidents. A complete knowledge of facts is the second principle for our work. Do we really look for *causes* or are we willing to accept *reasons* for accidents? Somtimes we hear too much about accident proneness and sociological factors and not enough about the practices and conditions that are the real causes. An excuse never prevented an accident. An alibi will claim more and more victims.

Not until the third principle, corrective action, is brought into our program will we get results. Here is where our three "E's" apply. Through engineering, enforcement and education our knowledge is applied and this creates and maintains interest. Once again we see the inter-relationship of basic principles. Use of the proper approach to our accident problem cannot help but involve all three.

SOCIETY STUDY VITAL TO PROFESSION

At the present time an important study is being made. A questionnaire was sent to each member of our American Society of Safety Engineers. While the response was outstanding for such surveys, still only 53 per cent of us returned the completed form. One interesting preliminary result: 97 different categories of titles used by people in our line of work were established. This indicates nothing but confusion. A look at corporate structure reveals a chairman of the board, a president, a vice president, a controller, a secretary, a treasurer. There is little question of responsibility in these titles. But just what is covered by a manager of loss prevention, a director of safety, a safety engineer, an accident prevention administrator, etc.? Where there is so much misunderstanding of fundamentals, perhaps this conglomeration of job titles is easily understood.

There is a story told of a couple on a motor trip who stopped at a country store to buy some gasoline and, while the tank was being filled, walked inside to look around. Much to their amazement all of the shelves were filled with packages of salt. As he paid the storekeeper, the driver remarked, "You must sell a lot of salt."

"No, I don't," was the reply, "but the fellow who sells me salt sure sells a lot of salt."

We must be like the salt salesman when it comes to safety. We must sell it convincingly enough to fill all of the shelves. The only way it can be done is through the application of the basic principles.

BECOMING A REGISTERED PROFESSIONAL ENGINEER

BY JOHN D. CONSTANCE, P.E.

Illustrations by courtesy of McGraw-Hill Book Company, Inc.

Engineering experience must be of a grade and character approved by the Board of Examiners.

Recently proposed as amendments to the Society's Constitution were changes in qualifications for membership which would encourage professional engineering registration. Since this November *Journal* issue goes to press before the Society's October 20 Annual Meeting, action taken this year on the proposed amendments cannot be known prior to publication. However, the fact that these changes in Society membership requirements have come up for discussion now indicates a serious interest, among many of the Society's members, in the subject of professional registration.

The *Journal* therefore was most pleased when Author John D. Constance, P.E., agreed to prepare for Society publication the article which starts on this page. In this article Mr. Constance has summarized the basic ideas of his recently published book, *How To Become a Professional Engineer*. *Journal* readers wanting the complete text will find the book available for purchase from the McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York 36, N.Y.

MORE AND MORE MEN engaged in engineering are obtaining professional licenses, as can be seen from the bar chart on page 56. Today total registration is close to 230,000. As licensing procedures are strengthened and simplified and more engineers become aware of the long range advantages of registration and learn how to go about it, the practice will become more widespread.

Your editors, in having me present my experience on this subject, have focused attention on the fact that engineering, as a profession, recognizes no limiting boundaries of any one branch of engineering. Engineers' registration offers the only practical method of achieving nationwide public recognition of *engineering* as a learned profession of high ethical and technological standards.

Registration laws regulating the practice of engineering have been enacted by all of our states, the District of Columbia and our remaining territorial possessions. Although only about 50 years have elapsed since the first engineering law was passed in Wyoming in 1907, there are close to 230,000 registrants on the lists of the 50 states and the territories. These laws establish the minimum qualifications of education and experience required of those who would practice or offer to practice professional engineering.

How does an individual engaged in engineering work go about getting his license? The trend toward uniformity of requirements, except for small differences due to state prerogative, eases the task of applying. The greatest effort will have to be made by those engineers of long established experience when writing up their record on the application form. Most

John D. Constance, P.E., Engineering Registration Consultant for 17 years, is a graduate chemical engineer who is registered in New York and New Jersey and holds a Certificate of Qualification, National Bureau of Engineering Registration. He is associated with refresher course work of ASME, AIEE, AICHE, ASCE.

engineers are too modest in reporting experience and lose much of the desired effect because of poor documentation.

Boards of Examiners have not been established for the purpose of imposing undue hardship on a candidate in his efforts to achieve professional status. Rather, the opposite is true. The boards are anxious to advance recognition of engineering and to enhance the prestige of the greatest possible number of those so qualified by encouraging such registration.

SEVEN REQUIREMENTS GENERALLY APPLY

Requirements for registration cannot be precisely defined because of the differences in the registration laws of the individual states and territories. However, engineers fall into any one of the categories shown in the table, "Classification of Applicants," on page 58. To make the point clearer, there are seven general requirements, the details of which may vary slightly from state to state:

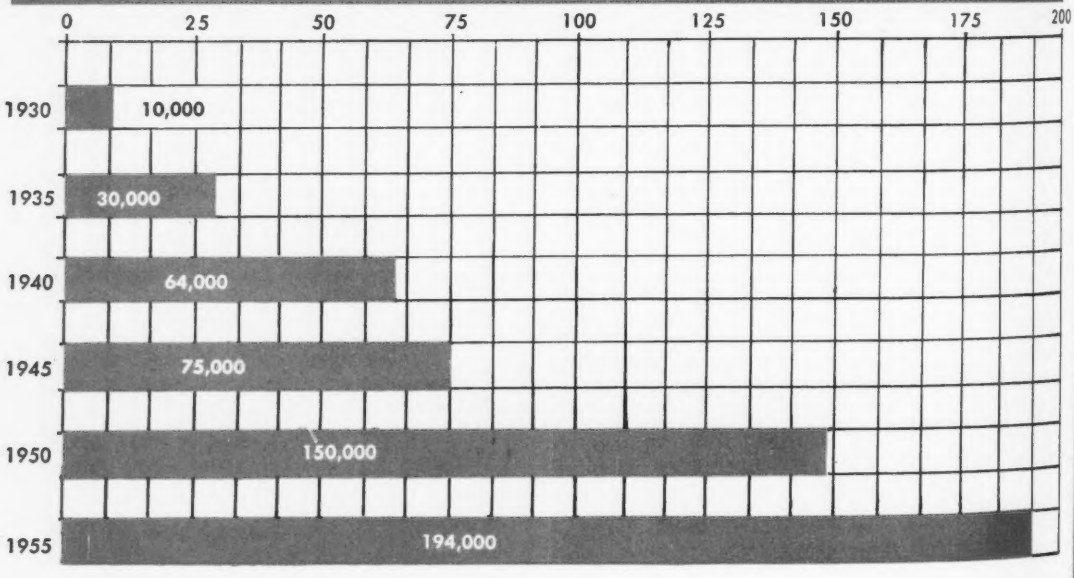
1. *Age:* Minimum age is 25 for full license. For engineer-in-training (EIT), age is 21.
2. *Citizenship:* Certain states require U. S. citizenship, others do not.
3. *Graduation:* Applicant must hold a high school diploma or the approved equivalent.
4. *Degree:* An engineering degree from an accredited institution or the equivalent in practical engineering experience is necessary.
5. *Experience:* Evidence of sufficient qualifying experience *as of date of application* must be presented.
6. *Character:* Reference from professional engineers personally acquainted with the applicant and attesting to his integrity are needed.
7. *Examination:* Unless waived by the board of examiners, the candidate must pass all parts of the professional examination given by his state.

CHECK LIST HELPS DEFINE PROBLEM

Use the following check list as a primary guidepost to a better understanding of your particular problem. Check and test yourself.

	YES	NO
1. Are you at least 25 years of age?	( )	( )
2. Are you a citizen or have you declared your intention of becoming one?	( )	( )
3. Have you a full high school education or the equivalent?	( )	( )
4. Are you presently engaged in engineering work?	( )	( )
5. Do you have an engineering degree?	( )	( )
6. Years of experience in engineering.	( )	
7. Are you in responsible charge of work or men?	( )	( )
8. Are you personally acquainted with at least three registered professional engineers?	( )	( )

Increase in professional engineer registrants (in thousands) from 1930 to 1955 is shown on bar chart below.



Source: National Society of Professional Engineers.

9. Do your responsibilities consist solely of repetitive operations, such as those of clip board data taker? ( ) ( )

This list can provide you with some interesting answers. For instance, item 5 can have a "no" and still qualify. Item 3 must be a "yes." Items 7 and 8 must be "yes"; 9 must be "no".

EXPERIENCE MUST BE OF BROAD SCOPE

Engineering experience must be of a grade and character satisfactory to the board. It is not the number of calendar years of experience but the nature of that experience that has the qualifying ingredient. To acquire the acceptable amount of experience requires more than a mere count of calendar years after graduation. This frequently proves to be a big disappointment to many men who are qualified in all other respects.

The National Council of State Boards of Engineering Examiners (NCSBEE) defines qualifying experience as "the legal number of minimum years of creative engineering work requiring the application of the engineering sciences to the investigation, planning, design and construction of engineering works. It is not merely the laying out of details of design, nor the mere performance of engineering calculations, writing specifications or making tests. It is rather a combination of these things plus the exercise of good judgment, taking into account economic and social factors, in arriving at decisions and giving advice to the client or employer, the soundness of which has been demonstrated in actual practice."

Acceptable engineering experience defies exact definition and, to some extent, is subject to the interpretation of the State Board of Examiners. However, it is predicated on a knowledge of engineering mathematics, physical and applied sciences, properties of materials and the fundamental principles of engineering design. A board will insist that an applicant's experience be broad in scope and of such nature as to have developed and matured the applicant's knowledge and judgment.

For the newly graduated engineer, some routine work is unavoidable and it may even be desirable. But to obtain the proper amount of experience he should seek the widest possible responsibility. Boards value experience of a broadly diversified character higher than more specialized activities. Boards license the engineer, not the specialist.

BOARDS RESTRICT EXPERIENCE CREDIT

All boards allow credit, subject to certain restrictions, for the engineering experience of the applicant. They *do not allow* experience credit for such as:

1. Teaching of nonengineering subjects in an engineering college or elsewhere.
2. Work projects before applicant would normally complete high school or would reach the age of 18.
3. Assignments in branches of the armed forces which do not involve engineering.
4. The work periods of a cooperative college course.
5. Vacation periods between the terms of a college course.
6. Sales work which does not involve the use of engineering knowledge.
7. Employment of a nonengineering nature even though it may be in connection with engineering works.
8. The duties of a contractor, superintendent or foreman on construction work unless such work involves engineering practices.
9. Correspondence school courses in engineering.

A man may acquire his experience in his home state or elsewhere. A year of graduate study in engineering which has led to a masters degree may be accepted as one of the years of experience required after graduation. Higher degrees also are looked upon as comparable to years of acceptable experience.

COMPLETE EXPERIENCE RECORD IMPORTANT

All too frequently the question of what constitutes acceptable experience is given only a passing thought. As a result, this vital question is not answered; important information is not well documented in the application. Nevertheless, in evaluating a man's experience, the board must reach its decision by what the applicant has stated on the form; its members cannot read in between the lines and cannot go by mere hearsay. Therefore, the application is not the place for modesty—nor is it enough to list job titles, no matter how impressive.

The record must give the complete story and must describe the applicant's function in detail, leaving the board with no doubt as to the exact nature and value of the applicant's experience.

Engineer-in-Training Certification — Engineering graduates and nongraduates having less than the required number of years of approved experience to qualify for full licensure may qualify for the EIT examination (see "Classification of Applicants" table). Upon successful completion of the examination, the EIT is granted a certificate attesting to the completion of the theoretical requirements for registration. This is not, however, a certificate authorizing the practice of engineering.

WRITTEN EXAMINATION GREATEST CHALLENGE

The written examination requires the expenditure of greatest effort for most candidates. Because it is the most convenient method of determining who will be licensed and who will not, it has been used since the beginning of the registration movement. For many years the various state boards have been making a concerted effort to create more uniformity in the types, quality and quantity of questions to be asked. Uniformity in the written examination, and in other requirements too, is essential to facilitate the free flow of engineering talent and services across state lines by permitting licensure by endorsement.

The written examination is a sampling process. It has to be in order to do the job effectively. This sampling process must afford good distribution and should be of a character to determine the ability to use the tools of the profession, instead of being a mere memory test.

Types of Problems—It is common practice among state boards to divide the written examination into two parts, given on succeeding days. One part deals with the basic material to evaluate the candidate's knowledge of engineering fundamentals and one part (the second day) is designed to determine the candidate's ability to apply the basics and to determine the extent of his experience obtained in engineering office or on the job.

The first day's questions usually cover the basic subjects of mathematics, physical and applied sciences (statics, dynamics, fluid mechanics, thermodynamics, electrical principles and mechanical design). Some boards arrange examination questions to include mathematics in the working out of solutions to problems in engineering economics, hydraulics, machine design and other subjects to reveal his mathematical ability. In this way examination time is used more efficiently.

Second Day's Questions—Questions for the second day are intended to sample judgment in economic considerations and practical approaches. The problem wording and terminology are so arranged as to require the candidate to call upon practical experience to develop the solution.

CLASSIFICATION OF APPLICANTS

Applicants Who Are . . .	And Have the Following Years of Approved Experience . . .	May Qualify for . . .
Graduates of accredited engineering schools.	Less than 4 years.	The preliminary or Engineer-in-Training written examination and EIT Certification.
	4 or more but less than 15 years.	The complete written examination and full P.E. Licensure.
	15 or more years.	Licensure by Endorsement, without written examination (if special requirements set by the individual state board are satisfied).
Graduates of other engineering schools.	Same as above, plus added approved time as determined solely by the individual State Board of Examiners.	Same as above, all items.
High school graduates with no engineering education.	8 years minimum. 12 years minimum. 25 years minimum.	Same as above, EIT. Same as above, P.E. Same as above, Endorsement.
High school graduates with partial educational credit from an accredited engineering school.	Same as above, less approved time for educational credit as determined solely by the individual state board of examiners.	Same as above, all items.

Source: "Are You Ready for Professional Registration?" by John D. Constance, P. E., *Chemical Engineering* (McGraw-Hill), August, 1955.

The trend today is toward more questions of the essay type—or the questions may involve a critical description of a project in which the candidate has had some experience. This will help in evaluating his grasp of engineering principles more than any number of academic problems could ever do.

Since the examination is given to men with minimum qualifications for registration, the questions represent the core of material.

LICENSURE BY ENDORSEMENT NOT COMMON

Lincensure by endorsement (without written examination) is the cherished ambition of all engineers but this special consideration befalls only a very few who are able to meet the severe requirements set by the board. Boards have been keenly aware of the position of mature engineers with long established practice and recognized standing. Many boards are now providing ways and means for these men to acquire registration without written examination.

The mere showing of calendar years of experience is insufficient to qualify an applicant for exemption, however. The qualification, "recognized standing," is something which cannot be precisely defined but boards have adopted criteria to evaluate professional standing. The rules cover these requirements to some extent but it is solely within the discretionary powers of the Boards of Examiners after carefully weighing the experience record and references produced by the applicant. Years of eminent practice or outstanding achievement weigh heavily in the applicant's favor. In addition, advanced studies, higher degrees, technical society activities, contributions to engineering knowledge and progress, inventions and patents, technical publications, high regard by fellow engineers, important developments and achievements and prior registration in another state are among the criteria used by the boards.

Before an applicant can consider himself so qualified for licensure by endorsement he must show, in most states, at least 15 years of approved engineering experience and practice after graduation from an accredited school of engineering. Nongraduates also may be considered but board requirements are even more rigid (see "Classification of Applicants" table).

PREPARING FOR THE WRITTEN EXAMINATION

Passing the written examination is generally the biggest stumbling block for the aspiring candidate. If you have the experience and the professional know-how, your State Registration Board *wants* you to have a PE license. It isn't the board's job to throw roadblocks into your path. Actually, the opposite is true.

Yet your board's first responsibility is to the public—to keep unqualified men from assuming responsibility for the design and construction of projects that involve health, life and safety. And it relies, in part, on the written examination to do the job.

The written examination need not be a stumbling block. Younger men seem to find the examinations easier than older, more mature candidates. And the state boards appreciate this. They presently are studying ways and means of giving a different type of examination to the older group. While such new tests would not be easier, they would give the older man an opportunity to show his ability to exercise mature judgment.

What are the objectives of the examination? Here's what your state board wants to know when you sit for it: 1) For the EIT or first day's examination, whether or not you understand basic engineering principles. 2) For the second day's examination, if your training and experience have taught you how to apply these principles to practical engineering problems.

Naturally, the test can't cover every detail of your engineering know-how. Since the examination must be a sampling process, you're likely to find enough questions that are right up your alley.

Although engineering college courses differ in some details, there is a core of common material. Such material is shown in the chart, "Common Material for First Day's Exam," on page 63.

Examination questions in safety engineering, when presented by boards, can be best exemplified by the following:

1. A manufacturing plant averages 2,000 employes on a 50 hour work week. In one year it experiences 25 disabling injuries for a total of 2,000 lost days.
   a. What is the plant accident frequency?
   b. What is the plant accident severity?
   c. Would you consider this a satisfactory record if the plant were a textile manufacturing plant? If it were in the paper and pulp industry? Why?
   d. Why is it usually considered undesirable to include first aid cases in the calculation of an accident frequency index?
2. Would you approve or condemn the following practices and why?
   a. Striking a cold chisel with a claw hammer.
   b. Striking a carpenter's chisel with a claw hammer.
   c. Using a pipe extension on a wrench to secure more leverage.
   d. Using a file to pry open a metal container.
3. Design a balcony of timber construction to be located in a small side bay of a plant for the

storage of 1,000 cubic feet of baled cotton goods. The location is such that existing walls will be used to support the back and two ends of the balcony. The balcony is to be 20 feet long and 10 feet wide at 10 feet above the main floor.

4. A line of abrasive wheels is exhausted from the same suction duct which runs along the back of the machines to a fan at one end of the duct. In order to have the same suction head at each machine, what variation is necessary in the duct size? What arrangement would you suggest for collecting and exhausting fumes which are heavier than air?

5. a. What is the principal eye hazard in electric welding operations and how is this hazard controlled in the case of the welder? In the cases of other employes in the vicinity?

   b. Is the use of oil or grease recommended in the maintenance of oxy-acetylene torches? Why?

   c. Describe the storage of full acetylene and oxygen cylinders.

This is the material usually covered during the first day's examination.

A glance at the chart ("Common Material for First Day's Exam") points up the basic importance of mathematics. Understanding the physical sciences depends on the solid foundation of mathematics. Examiners, recognizing the importance of this tool, commonly ask for mathematical solutions of physical problems.

Boards aren't interested in asking questions which call for extremely long answers. Usually, a question is supposed to take from 20 to 30 minutes. Some should take even less time. Most examiners give equal weight to all questions, thus discouraging long answers.

What are board practices in conducting examinations? Some boards use the open book test; others use closed book. Open book measures your ability to recognize and correctly apply engineering principles. Also, some examiners include a limited number of closed book questions, especially when such questions include definitions that easily could be copied from a book.

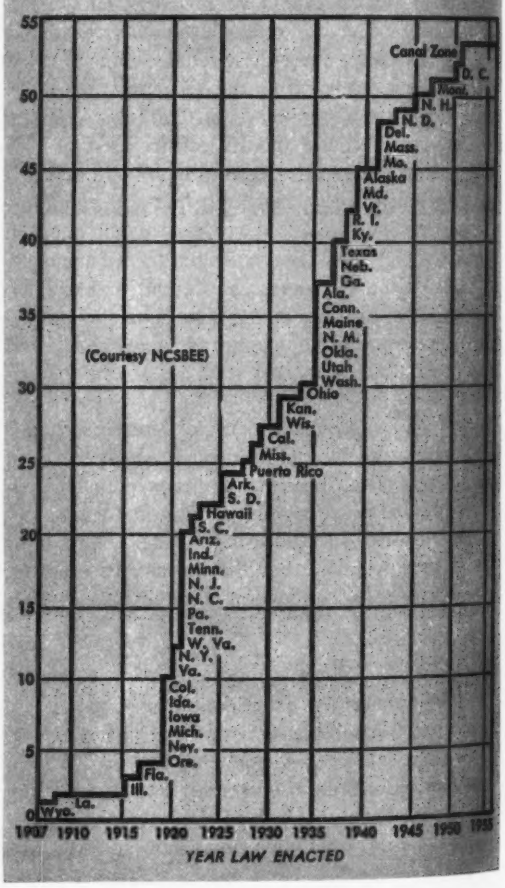
When preparing for the written examination an early start is important. Your state board secretary (see list at end of article) can tell you where to get information on enrolling in refresher courses. He also will tell you where to get copies of past examinations. If you've had many years of experience, it may pay you to check into the possibilities of getting a waiver of a portion of the written examination. Success in this area depends, in part, on how carefully you prepare your experience record. Here you may need help.

If attending refresher courses is inconvenient, look into the matter of specially prepared texts aimed at preparing you for the examination. Avoid "cook book" style preparation. If you simply work out problems without getting a good understanding of fundamentals, you are likely to trap yourself into a feeling of hollow security.

Look over past examinations and you will see that the core of the material they cover remains pretty much the same from year to year. But the boards leave the "cook book" engineer high and dry by giving the newer examination problems a different slant. So there is no easy substitute for careful preparation.

Examiners bar textbooks from closed book examinations. For open book tests you will be allowed to

Progressive history of engineer registration in the United States from 1907 to 1955 is illustrated graphically, with vertical scale showing numbers of states and territories having registration laws.



use reference books, text books, personal note books and other material that may help. Texts used in college or in other courses are first rate sources of information. Also, compilations of past examinations can reveal much useful data. Past examinations will familiarize you with the wording of problems and with the technical areas the boards generally cover. Most important, you will build up your confidence.

SITTING FOR THE EXAMINATION

Besides knowing your field of engineering "cold," you should master the art of taking the PE examination. Here are some pointers:

1. Get a good night's rest before the examination.
2. Get to the examination room early. Don't rush.
3. Sit in a well lighted area of the room.
4. Be sure to read all directions carefully.
5. Write neatly—usually writing in ink is required.
6. Write on one side of the paper only.
7. Work out no more than one solution on any one sheet of paper.
8. Draw a diagram to help explain each solution.
9. Do the easiest problem first. It will build confidence.
10. Allow yourself equal time for each problem.
11. Don't linger over problems you cannot answer.

Read through the entire examination before attempting to answer any of the questions. As you read, check the problems with which you are most familiar. The first reading will take you no more than 10 to 15 minutes. And you will find it's time well spent. Then divide your time equally among the problems you choose to answer. When the time you have allotted to a problem runs out, go on to the next one—even if you're not finished. *Remember:* Examiners give you a large part of the credit for simply setting up the problem and showing an understanding of what is wanted. So it is not smart to spend a great deal of time trying to get refined answers at the expense of completely ignoring another problem that you could answer with relative ease.

By taking the easiest problems first, you will build up confidence and ease off tension.

A common complaint of candidates (post mortems): "I couldn't remember the simplest formula in the examination room. But now that it's over I could wade through these problems with flying colors." This candidate was prepared but he could not respond. Why? He had suffered emotional block. You can avoid this pitfall simply by relaxing. If you feel tension mounting during the examination, ask permission to leave your desk for a break. But remember: *The best defense against emotional block is careful preparation.*

What To Take into the Examination—You will get detailed instructions from your state board on this score. The board generally will require some form of identification or admission card. In addition, these items will come in handy: wrist watch, fountain pen and ink, pencils, slide rule, log tables, cross-section paper, scratch paper, ruler, scale, triangles, protractor, reference books (if permitted).

ACCREDITING OF ENGINEERING SCHOOLS

Some boards accept engineering schools accredited by the Engineers' Council for Professional Development. Others have compiled their own lists from independent investigation. If a school is on the accredited list, it does not necessarily follow that all its engineering courses are similarly approved. In any event, if the applicant's school or course pursued does not appear on the official accredited list, he is advised to write to his board for confirmation. Further, the applicant may be required to write to his school registrar, asking the school to formulate plans toward ultimate accredited standing with the board.

STATES AUTHORIZE ENGINEERS' SEAL

All states and territorial possessions authorize or require professional engineers to have a personal seal or stamp, and prescribe the requirements and limitations of its use.

The seal serves a double purpose; it identifies the practitioner whose name and number it bears and it indicates that he has obtained state authorization to engage in professional practice. In the first instance, it establishes responsibility for the work with which it is connected and, in the second, it stands as a hallmark of an acceptable degree of professional competence.

STEP-BY-STEP PROCEDURE TO FOLLOW

The step-by-step procedure for becoming a registered professional engineer is as follows:

1. Write the secretary of your State Board of Examiners for application forms and a copy of the state registration law.
2. Check the requirements listed in the law.
3. Fill in the necessary forms and obtain the required references.
4. Return the application and other papers with the statutory fee.
5. Await the board's action.
6. Follow the board's instructions. It is most likely you will be directed to take the written examination unless you qualify for licensure by endorsement. Some boards request interviews for borderline cases.

7. Await the results of the written examination or interview. Notification time varies from state to state.

Study Helps—The applicant should first determine if he is qualified for either the written examination or licensure by endorsement before exploring the matter of refresher courses, tutoring or home study preparation. A good knowledge of filing procedure will be helpful, with the board having the final say.

The state board secretary is in the best position to furnish the candidate with a list of references and study helps, together with places where refresher courses are available. The National Society of Professional Engineers and its state and local chapters always are most helpful in making this information known. A number of industrial organizations are providing their qualified engineers with refresher courses. For the older, more mature men, they furnish guidance procedures for exploring the possibility of licensure by endorsement.

HOW TO CONTACT YOUR STATE BOARD OF ENGINEERING EXAMINERS

ALABAMA
State Board of Registration for Professional Engineers and Land Surveyors, Clifton C. Cobb, Executive Secretary, 64 N. Union St., Montgomery 4.

ALASKA
Board of Engineers and Architects Examiners, R. V. Killewich, Secretary, Box 1416, Juneau.

ARIZONA
State Board of Technical Registration, Mrs. Rayma Neeb, Executive Secretary, Room 403, 128 N. First Ave., Phoenix.

ARKANSAS
State Board of Registration for Professional Engineers, B. Allan Curry, Secretary, P. O. Box 1117, Park Hill Station, North Little Rock.

CALIFORNIA
State Board of Registration for Civil and Professional Engineers, Arthur I. Flaherty, Executive Secretary, 529 Business and Professions Bldg., 1020 N. St., Sacramento 14.

CANAL ZONE
Board of Registration for Architects and Professional Engineers, Gerald A. Doyle, Jr., Secretary, P. O. Box 223, Balboa Heights.

COLORADO
State Board of Registration for Professional Engineers, James S. Findley, Assistant Secretary, Room 220, Majestic Bldg., Denver 2.

CONNECTICUT
State Board of Registration for Professional Engineers and Land Surveyors, Charles H. Coogan, Jr., Secretary, 30 Cook St., Hartford 6.

DELAWARE
State Board of Registration for Professional Engineers and Land Surveyors, Frank T. Lynch, Secretary, 11 E. 12th St., Wilmington 1.

DISTRICT OF COLUMBIA
Board of Registration for Professional Engineers, Mrs. Lacey W. Coad, Executive Secretary, 1740 Massachusetts Ave., N.W., Washington 6.

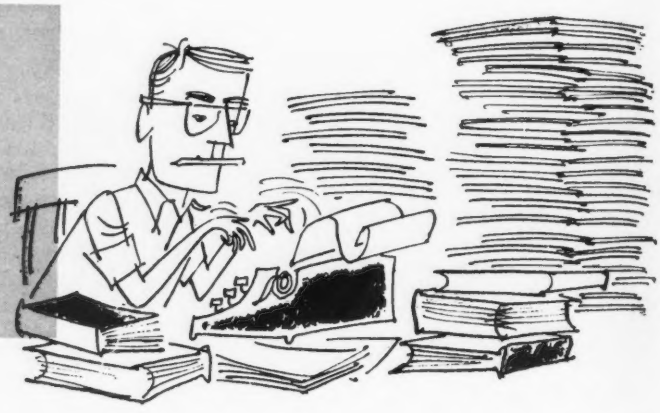
FLORIDA
State Board of Engineer Examiners, Mrs. Ann P. Clover, Executive Secretary, 408 John F. Seagle Bldg., Gainesville.

GEORGIA
State Board of Registration for Professional Engineers and Land Surveyors, Cecil L. Clifton, Joint Secretary, 224 State Capitol, Atlanta.

HAWAII
Board of Registration for Professional Engineers, Architects and Land Surveyors, William C. Furer, Executive Secretary, 1909 Aleo Place, Honolulu 14.

IDAHO
State Board of Engineering Examiners, Orland C. Mayer, Secretary, Idaho Power Company Bldg., Boise.

Contributions to the technical literature and technical publications rate high as evidence of "recognized standing" which may qualify applicant for licensure by endorsement.



ILLINOIS
Professional Engineers' Examining Committee, Fredric B. Selke, Superintendent of Registration, Room 109, Capitol Bldg., Springfield.

INDIANA
State Board of Registration for Professional Engineers and Land Surveyors, Ferdinand Jehle, Secretary, 145 W. Washington St., Room 502, Indianapolis 4.

IOWA
State Board of Engineering Examiners, William Grant Cunningham, Secretary, State House, Des Moines 19.

KANSAS
State Board of Engineering Examiners, Mrs. Della Sterrett, Executive Secretary, 1159-W, State Office Bldg., Topeka.

KENTUCKY
State Board of Registration for Professional Engineers, C. S. Crouse, Secretary, 223 Mineral Industries Bldg., 120 Graham Ave., Lexington.

LOUISIANA
State Board of Registration for Professional Engineers and Land Surveyors, F. W. MacDonald, Executive Secretary, Tulane University Station, New Orleans 18.

MAINE
State Board of Registration for Professional Engineers, Bryant L. Hopkins, Secretary, Box 103, Waterville.

MARYLAND
State Board of Registration for Professional Engineers and Land Surveyors, J. W. Gore, Secretary, 1101 Key Highway, Baltimore 30.

MASSACHUSETTS
State Board of Registration of Professional Engineers and Land Surveyors, Office of the Board, Room 34, State House, Boston 33.

MICHIGAN
State Board of Registration for Architects, Professional Engineers and Land Surveyors, Henry G. Groehn, Executive Secretary, 1604 Cadillac Square Bldg., Detroit 26.

MINNESOTA
State Board of Registration for Architects and Proneers and Land Surveyors, Helen D. Carlson, Executive Secretary, 316 New York Bldg., St. Paul 1.

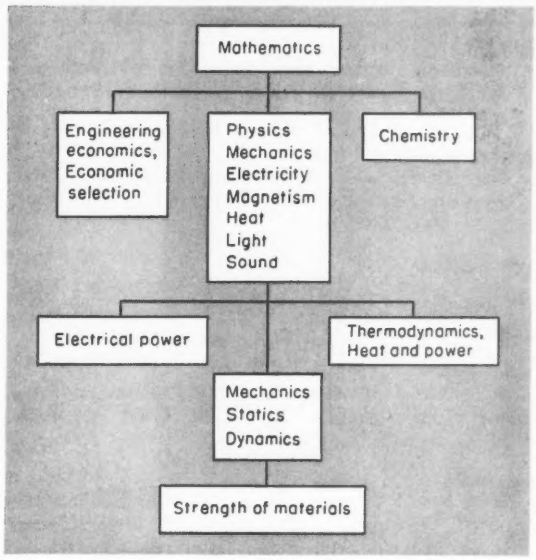
MISSISSIPPI
State Board of Registration for Architects, Engineers, O. B. Curtis, Sr., Secretary, P. O. Box 3, Jackson.

MISSOURI
State Board of Registration for Architects and Professional Engineers, Mrs. Clemmie V. Wall, Secretary, Box 184, Jefferson City.

MONTANA
State Board of Registration for Professional Engineers and Land Surveyors, Harvey W. Taylor, Executive Secretary, P. O. Drawer 291, Capitol Post Office, Helena.

NEBRASKA
State Board of Examiners for Professional Engineers and Architects, Roy M. Green, Secretary, 512 Trust Bldg., 941 "O" St., Lincoln 8.

COMMON MATERIAL FOR FIRST DAY'S EXAM

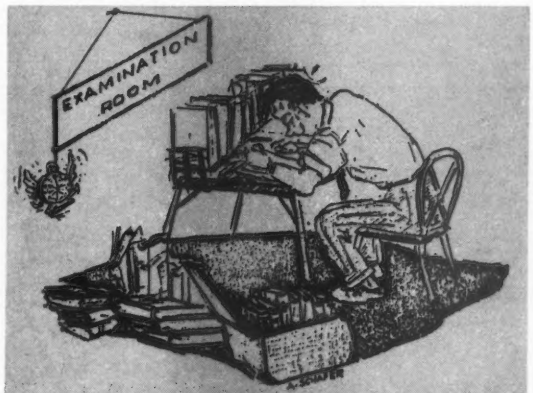


NEVADA
State Board of Registered Professional Engineers, Stanley G. Palmer, Secretary, University Station, P. O. Box 9052, Reno.

NEW HAMPSHIRE
State Board of Registration for Professional Engineers, W. E. Haynes, Secretary, c/o Secretary of State, State House, Concord.

NEW JERSEY
State Board of Professional Engineers and Land Surveyors, Thomas E. Heathcote, Secretary, 1100 Raymond Blvd., Newark 2.

NEW MEXICO
State Board of Registration for Professional Engineers and Land Surveyors, Mrs. Sybel Clagett, Assistant Secretary, P. O. Box 2074, Santa Fe.



IN THE EXAMINATION ROOM

NEW YORK
State Board of Examiners of Professional Engineers and Land Surveyors, Newell L. Freeman, Secretary, 23 S. Pearl St., Albany 7.

NORTH CAROLINA
State Board of Registration for Professional Engineers and Land Surveyors, Robert B. Rice, Secretary, P. O. Box 5131, Raleigh.

NORTH DAKOTA
State Board of Registration for Professional Engineers, A. L. Bavone, Secretary, P. O. Box 1265, Minot.

OHIO
State Board of Registration for Professional Engineers and Surveyors, Robert N. Waid, Secretary, 21 W. Broad St., Columbus 15.

OKLAHOMA
State Board of Registration for Professional Engineers, Gwynne B. Hill, Secretary, 2901 Classen Blvd., 225 Cameron Bldg., Oklahoma City 6.

OREGON
State Board of Engineering Examiners, E. A. Buckhorn, Secretary, 717 Board of Trade Bldg., Portland 4.

PENNSYLVANIA
State Registration Board for Professional Engineers, Miss Louise J. Franklin, Secretary, 570 Education Bldg., Harrisburg.

PUERTO RICO
Board of Examiners of Engineers, Architects and Surveyors, Joaquin Mercado-Cruz, Secretary, P. O. Box 3271, San Juan.

RHODE ISLAND
State Board of Registration for Professional Engineers and Land Surveyors, Philip S. Mancini, Secretary, 246 State Office Bldg., Providence.

SOUTH CAROLINA
State Board of Engineering Examiners, Miss Miriam E. Gibbons, Assistant Secretary, P. O. Drawer 1404, Columbia.

SOUTH DAKOTA
State Board of Engineering and Architectural Examiners, Earl D. Dake, Secretary, c/o South Dakota School of Mines and Technology, Rapid City.

TENNESSEE
State Board of Architectural and Engineering Examiners, William H. Rowan, Secretary, P. O. Box 1810, Station "B," Nashville.

TEXAS
State Board of Registration for Professional Engineers, Thomas C. Green, Executive Secretary, 308 W. 15th St., Room 403, Austin 14.

UTAH
Representative Committee of Professional Engineers and Land Surveyors, Frank E. Lees, Director, 318-A State Capitol Bldg., Salt Lake City.

VERMONT
State Board of Registration for Professional Engineers, Walter D. Emerson, Secretary, c/o Norwich University, Northfield.

VIRGINIA
State Board for Examination and Certification of Professional Engineers, Architects and Land Surveyors, Turner C. Burton, Secretary, P. O. Box 1-X, Richmond.

WASHINGTON
State Board of Registration for Professional Engineers and Land Surveyors, Edward C. Dohm, Secretary, Department of Licenses, Professional Div., General Administration Bldg., Olympia.

WEST VIRGINIA
State Registration Board for Professional Engineers, Robert Williamson, Jr., Secretary, 301 Morrison Bldg., Charleston.

WISCONSIN
State Registration Board of Architects and Professional Engineers, W. A. Piper, Secretary, 1140 State Office Bldg., Madison 2.

WYOMING
State Board of Examining Engineers, Mrs. Wilma Lang, Assistant Secretary, 201 State Capitol Bldg., Cheyenne.

The registered engineer's seal, his personal property, identifies his work and serves as a hallmark of professional competence.

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JOURNAL OF THE AMERICAN SOCIETY OF SAFETY ENGINEERS

References are to volume number and page. Page numbers in the various issues are as follows: pages 1-16, February, 1959 (Number 1); pages 17-32, May, 1959 (Number 2); pages 33-48, August, 1959 (Number 3); pages 49-64, November, 1959 (Number 4).

A

Accident Causes: *see Causes*
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AMERICAN SOCIETY OF SAFETY ENGINEERS

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THE American Society of Safety Engineers has established the following classifications of active membership.

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